

IN THE CLAIMS

This listing of the claim will replace all prior versions and listings of claim in the present application.

Listing of Claims

1. (original) A magnetic recording apparatus comprising a perpendicular magnetic recording medium having a perpendicular magnetization film formed either directly or via an intermediate layer on a magnetic back film having a plurality of soft magnetic films laminated therein and a recording-and reproducing head, wherein the saturation magnetization (B_{sm}) and a thickness (t) of the soft magnetic film closest to the perpendicular magnetization film in the magnetic back film, and the shortest bit length (B_{min}) in magnetic recording and the average saturation magnetization (M_s) of the perpendicular magnetic film have the relationship represented by $0.5B_{min} \cdot M_s \leq B_{sm} \cdot (t < 100 \text{ nm})$.

2. (original) A magnetic recording apparatus comprising a perpendicular magnetic recording medium having a perpendicular magnetization film formed either directly or via an intermediate layer on a magnetic back film having a plurality of soft magnetic films laminated therein and a recording-and reproducing head, wherein the saturation magnetization (B_{sm}) and a thickness (T_m) of the m -th soft magnetic film in the magnetic back film, and the saturation magnetization (B_{sh}) and track width (T_w) of the magnetic pole material for the recording head have the relationship represented by $0.16B_{sh} \cdot T_w \leq \sum(B_{sm} \cdot T_m)$.

3. (original) A magnetic recording apparatus comprising a perpendicular magnetic recording medium having a perpendicular magnetization film formed either directly or via an intermediate layer on a magnetic back film having a plurality of soft magnetic films laminated therein and a recording-and reproducing head, wherein the saturation magnetization (B_{sm}) and a thickness (T_m) of the m-th soft magnetic film in the magnetic back film, and the saturation magnetization (B_{sh}) and track width (T_w) of the magnetic pole material for the recording head having the relationship represented by $\sum(B_{sm} \cdot T_m) \leq T_w$.

4. (original) The perpendicular magnetic recording apparatus according to claim 1, wherein the soft magnetic films of the perpendicular magnetic recording medium contain Fe-Si-B, Fe-B-C, Fe-B-C-Si, Fe-Ta-c, Fe-Si-Al, Fe-Co-C, Co-Nb-Zr, Co-Mo-Zr, Co-Ta-Zr-, Co-W-Zr, Co-Nb-Hf, Co-Ta-Hf and Co-W-Hf alloys.

5. (original) The perpendicular magnetic recording apparatus according to claim 2, wherein the soft magnetic films of the perpendicular magnetic recording medium contain Fe-Si-B, Fe-B-C, Fe-B-C-Si, Fe-Ta-C, Fe-Si-Al, Fe-Co-C, Co-Nb-Zr, Co-Mo-Zr, Co-Ta-Zr, Co-W-Zr, Co-Nb-Hf, Co-Mo-Hf, Co-Ta-Hf and Co-W-Hf alloys.

6. (original) The perpendicular magnetic recording apparatus according to claim 3, wherein the soft magnetic films of the perpendicular magnetic recording medium contain Fe-Si-B, Fe-B-C, Fe-B-C-Si, Fe-Ta-C, Fe-Si-Al, Fe-Co-C,

Co-Nb-Zr, Co-Mo-Zr, Co-Ta-Zr, Co-W-Zr, Co-Nb-Hf, Co-Mo-Hf, Co-Ta-Hf and Co-W-Hf alloys.

7. (new) A perpendicular magnetic recording medium comprising:
a magnetic back film formed on a substrate; and
a perpendicular magnetization film formed above the magnetic back film,
wherein the magnetic back film comprises:
a plurality of soft magnetic films, and
a non-magnetic layer inserted between each pair adjacent soft magnetic films
and
wherein the magnetizations of each soft magnetic film of each pair of adjacent
soft magnetic films has a different magnetization orientation from the other soft
magnetic film of said pair of adjacent soft magnetic films.

8. (new) The perpendicular magnetic recording medium according to
claim 7, wherein film formed below the perpendicular magnetization film have a
thickness of 10 to 100 nm.

9. (new) The perpendicular magnetic recording medium according to
claim 7, wherein the soft magnetic film formed underneath the perpendicular
magnetization film are Fe-Si-B, Fe-B-C, Fe-B-C-Si, Fe-Ta-C, Fe-Si-Al, Fe-Co-C, Co-
Nb-Zr, Co-Mo-Zr, Co-Ta-Zr, Co-W-Zr, Co-Nb-Hf, Co-Mo-Hf, Co-Ta-Hf and Co-W-Hf
alloys.

10. (new) The perpendicular magnetic recording medium according to claim 7, wherein the non-magnetic film, an anti-ferromagnetic film or a ferromagnetic film is formed under the magnetic back film.

11. (new) The perpendicular magnetic recording medium according to claim 7, wherein the non-magnetic film comprises an element selected from the group consisting of B, C, Mg, Al, Si, Ti, V, Cr, Cu, Zr, Nb, Mo, Ru, Hf, Ta, W and Au, an alloy comprising elements B, C, Mg, Al, Si, Ti, V, Cr, Cu, Zr, Nb, Mo, Ru, Hf, Ta, W and Au as main components, a compound selected from the group consisting of Si_3N_4 , BN, B_4C , NiO, Al_2O_3 , SiO_2 , CaO, ZrO_2 and MgO, or a mixed crystal comprising compounds Si_3N_4 , BN, B_4C , NiO, Al_2O_3 , SiO_2 , CaO, ZrO_2 and MgO.